197
USDA FOREST SERVICE
RESEARCH PAPER PNW-13

SAW LOGS IN TREES

GRADING SUGAR PINE

JOHN W. HENLEY

PACIFIC NORTHWEST FOREST AND RANGE EXPERIMENT STATION
PORTLAND, OREGON

ABSTRACT

Small limbs and small overgrown limbs cause problems when grading saw logs in sugar pine trees. Surface characteristics and lumber recovery information for 426 logs from 64 sugar pine trees were examined. Resulting modifications in the grading specification that allow a grader to ignore small limbs and small limb indicators do not appear to decrease the performance of the grading system.

Keywords: Sugar pine, log grades.

INTRODUCTION

In 1962, specifications for an improved system for grading ponderosa pine (*Pinus ponderosa* Laws.) and sugar pine (*Pinus lambertiana* Dougl.) saw logs in trees were published.[1] A supplementary publication provided detailed information on the identification, definition, and significance of surface imperfections visible on ponderosa and sugar pine logs.[2] Together they provided a single standardized grading system for ponderosa and sugar pine. This improved system is used by foresters and cruisers in various operations requiring log grading.

Specifications for the improved grades are briefly summarized as follows:

	Defects Permitted	
Grade	*Primary (log knots)*	*Secondary (scars, etc.)*
1	One log knot not over one-half-inch diameter	Confined to three panels or less
2	Confined to four panels or less	Secondary plus primary confined to six panels or less
3	Six panels free of all grading defects	
4	(a) 80 percent bark limbs (b) Bark limbs not exceed one-sixth log diameter; other log knots not exceed one-twelfth log diameter (c) Not more than 24 near maximum size	Confined to three panels or less
5	All other logs, if net scale one-third or more of gross scale	

[1] *Edward M. Gaines. Improved system for grading ponderosa pine and sugar pine saw logs in trees. USDA Forest Serv. Pac. Southwest Forest & Range Exp. Stn. Tech. Pap. 75, 21 p., illus., 1962.*

[2] *Willard L. Jackson. Guide to grading defects in ponderosa and sugar pine logs. USDA Forest Serv. Pac. Southwest Forest & Range Exp. Stn., 34 p., illus., 1962.*

In grading specifications, all limbs, limb stubs, and overgrown limbs[3] are classified as primary defects. They are termed log knots.

Secondary defects include scars of all types, burls, forks, crooks, cankers, and cracks due to natural causes. They have to be recognized and grouped into panels. A panel is a unit of log surface used to define extent of defect grouping or extent of defect-free areas. The size of a panel is one-quarter the log circumference by 4 feet long. Panels are located individually and may be scattered over the log surface.

Problems are encountered in applying the specifications to sugar pine. The texture and dark color of sugar pine bark masks small dead limbs and overgrown limbs so that they are not readily visible (fig. 1). They are difficult to recognize and group into panels as specified in the Improved Grading System. As a result, a large amount of time is spent in grading. Failure to obtain consistent grading results is a related problem.

The problems encountered in applying the grading specifications to sugar pine would be alleviated if small limbs and indicators of overgrown limbs were eliminated from the primary defect classification. If they were not classified as defects, they could be ignored in grading. However, these changes in the grading specifications could reduce the system's performance in estimating the value of logs. This might be undesirable, depending on the cost of considering the indicator specification and the degree of performance reduction. There is also the question of the proper definition of a small limb: 1/2-inch, 1-inch, or some other size.

Discussions of these problems with managers of sugar pine stands and users of the grading system resulted in a study of various modifications in the improved grading system. A modification was sought that would reduce the problems connected with application of the specifications and would perform acceptably. The results of this study are presented for the information and consideration of those concerned with grading sugar pine trees.

PROCEDURE

A review of the work leading to the improved system showed that information on more than 8,900 logs had been used to develop the system. The information consisted of lumber recovery data and detailed records of surface characteristics for individual logs. About 600 of these logs were sugar pine. The information on these logs had been obtained in two mill studies conducted in central and northern California. In these studies, logs had been selected in the mills' log yards. There, detailed diagrams were made of the surface characteristics.

Review of these diagrams indicated that very few of the small limbs and overgrown limbs illustrated in figure 1 were noted as being present on the logs. It is probable that the logging and handling operations that preceded the diagraming phase of these

[3] *Also known as knot indicators. They are scars or bark distortions that indicate the presence of a knot in the underlying wood.*

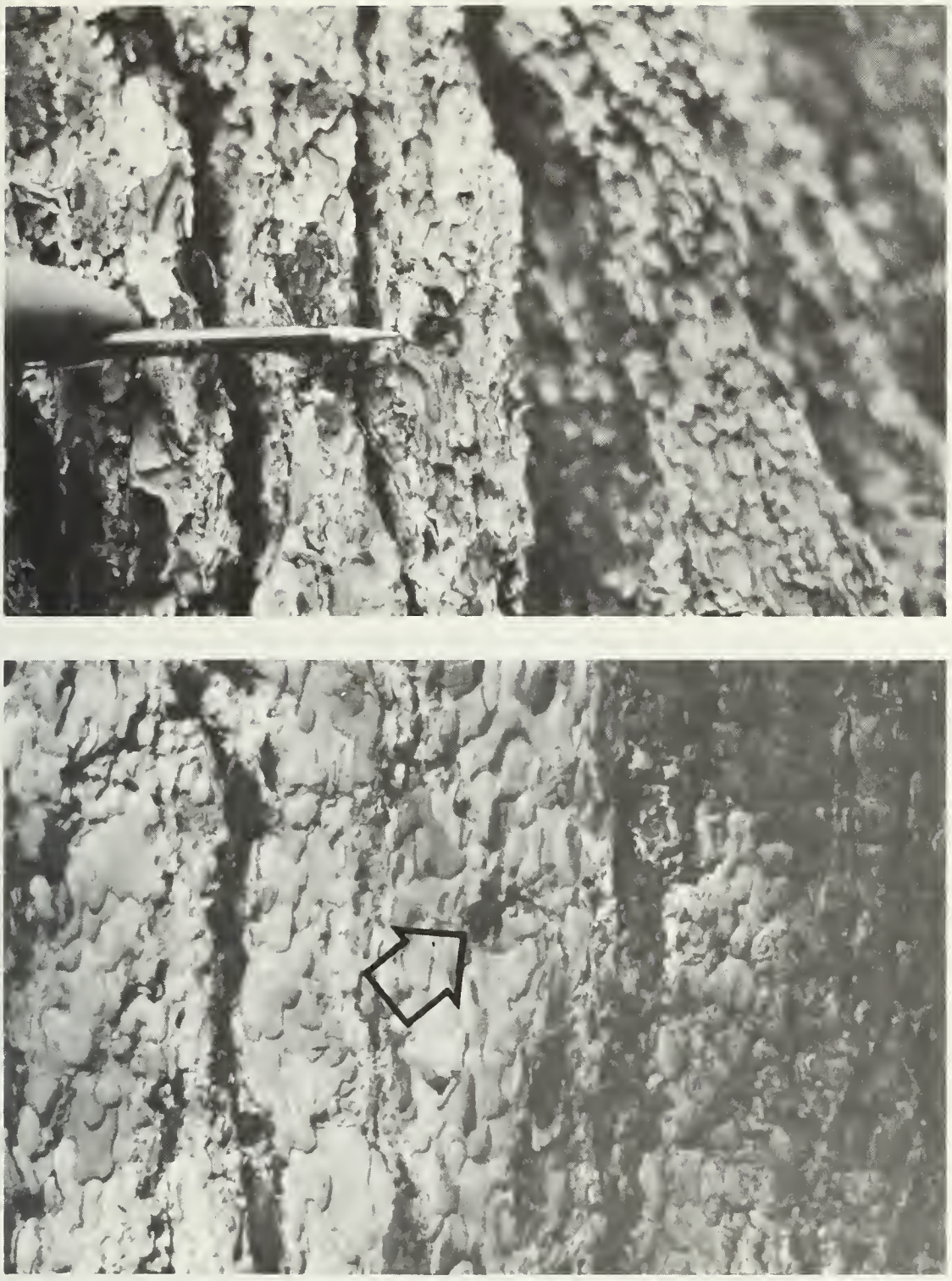

Figure 1.—Examples of small overgrown limbs in sugar pine logs that are difficult to recognize and group into panels for grading.

studies obliterated many of the small surface characteristics that caused application problems. It is also probable that many of the small surface characteristics were not diagramed because they were not considered significant. Since the available data did not appear to be adequate, a new set of data was obtained for the study.

During the summer and fall of 1970, surface characteristics and lumber recovery information were obtained on a sample of sugar pine logs. This information was obtained in cooperation with the Pacific Northwest Region of the National Forest System. Sixty-four trees were selected from five timber stands tributary to Medford, Oregon. The location, type, and size-of-surface characteristics present on the butt 32-foot portion of the tree stems were recorded (diagramed) while the sample trees were still standing. This was done with the use of a graduated 32-foot pole and 6x35 binoculars. After the trees were felled, but prior to logging, this record was checked and the characteristics present on the upper portion of the tree stem diagramed. More small limbs and overgrown limbs were diagramed per log in this study than were in the studies mentioned earlier. The merchantable logs bucked from the tree stems were then hauled to a sawmill and processed into lumber. Individual log identity was maintained during this process to obtain the lumber grade volume sawn from each log.

A single expression for the quality of lumber sawn from each log was desired for evaluation of grading performance. Log value was used for this purpose. A set of 1969 lumber grade prices was used to compute a total value for the lumber produced from each log. The prices used are as follows:

B and Better Select	$357.52
C Select	351.74
D Select	277.72
Moulding	254.74
No. 3 Clear	196.95
No. 1 Shop	203.94
No. 2 Shop	159.86
No. 3 Shop	125.93
Nos. 1 and 2 Common	138.81
No. 3 Common	105.70
No. 4 Common	84.11
No. 5 Common	55.08

The objective was to establish comparable values for individual logs, not "real" values as would be used in appraisals.

A basic question was the relative effectiveness of alternate grading systems for estimating log value. In common usage, the value of logs in a grade is estimated with a regression or curve that recognizes diameter-value relationships. The effectiveness or accuracy of a grading system is related to the variability associated with the value estimates for each log grade.

A general model was used for evaluating the effectiveness of alternate log grading systems. The model involved fitting regressions of the form:

$$Y = a + b_1X + b_2X^2 + b_3X^3$$

in which

Y = value per thousand board feet of total lumber volume in the log ($/MLV), and

X = diameter of the log in inches.

The regressions were fitted to the logs of a given grade. The variance around the regression (first, second, or third degree polynomial) that best fit the logs in a grade was determined. The variances of the log grades in a system were pooled. The pooled variance furnished a measure of the proportion of the variability in $/MLV that could be attributed to log grade segregation and regression on diameter. This proportion was used as the criterion of accuracy for modifications of the improved system.

The model was used first to test the existing log grade system and establish a base to evaluate the performance of proposed modifications in the grading system. The existing grading system was applied to the study logs under two conditions. First, they were graded using the diagramed record of surface characteristics. This grade is assumed to be equivalent to grading log segments in the standing tree, as the diagrams contain a record of all the surface characteristics that could be seen in the standing tree.

The study logs were also visually graded in the mill yard by a regional check scaler. This is assumed to be equivalent to grading from diagramed records made in the mill yard. As such, this grading was done under conditions similar to those used to develop the improved grading system.

The statistical model was then used to test and compare modified versions of the existing system. The system was modified by defining various sizes of small limbs, limb stubs, and overgrown limbs as nondefects. Several increments of size were considered for overgrown limbs. Of these, 1 and 2 inches were selected for statistical evaluation. One size, one-half inch, was considered for limbs and limb stubs.

RESULTS

Lumber recovery and surface characteristic information was obtained for 426 logs. Their small end diameter ranged from 8 to 51 inches. The value per thousand board feet of total lumber volume in the logs ($/MLV) varied from $85 to $315. The distribution and variation of $/MLV with log diameter is shown by the scatter diagram in figure 2. A trend of increasing $/MLV with increasing log diameter is evident. The proportion of the variance of $/MLV that can be attributed to its regression on log diameter is 64 percent.

Performance statistics obtained from grading the sample logs under four different situations are shown in table 1. System 1 is the result of grading the diagramed

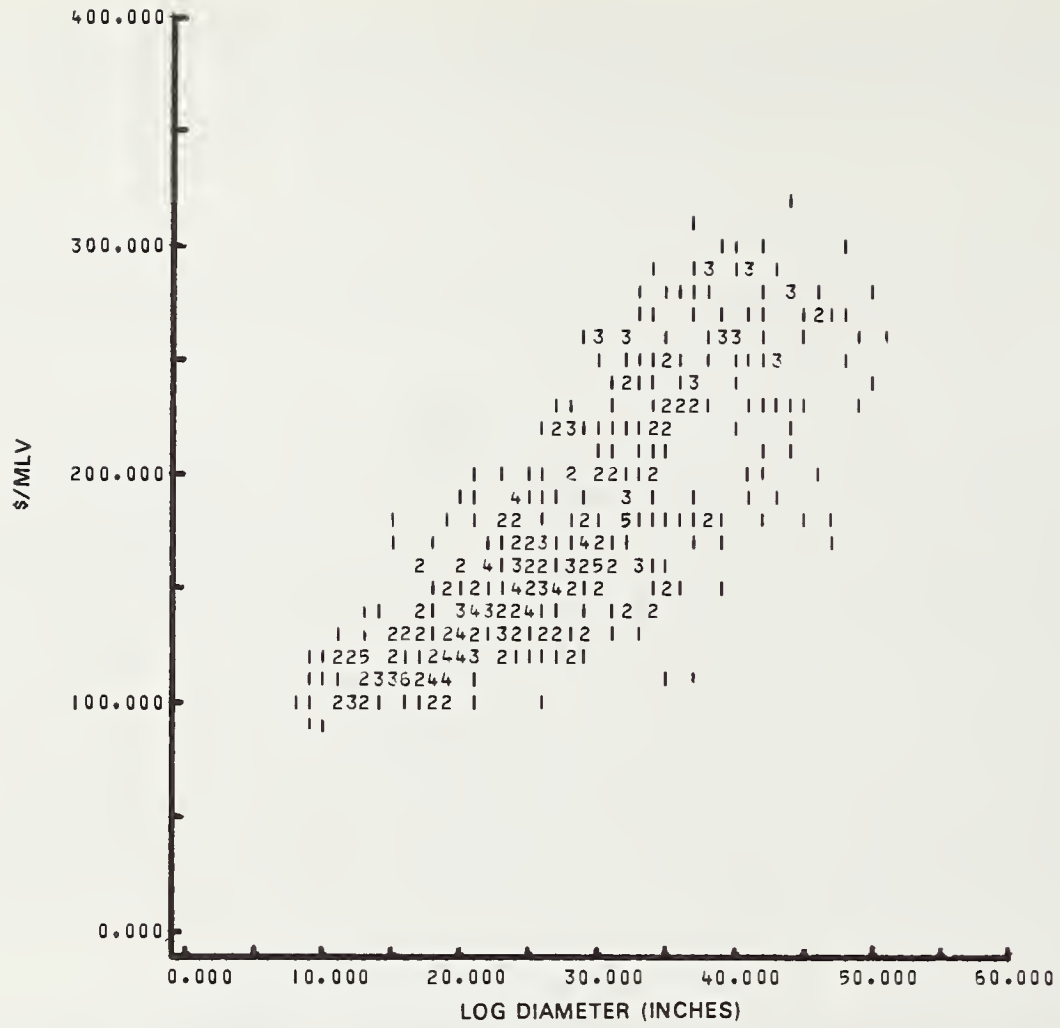

Figure 2.—Number of sample logs by 1-inch diameter and $10.00 $/MLV classes. Total number is 426.

records with the published system. System 2 results from the check scaler grading the logs in the mill log yard. System 3 results were obtained by grading the diagramed records with a modified grading system. In this grading system, overgrown limbs 1 inch or less in diameter and limbs and limb stubs one-half inch or less in diameter were not considered to be defects.[4/] In System 4, overgrown limbs 2 inches or less in diameter and limbs and limb stubs one-half inch or less in diameter were not considered to be defects.

The performance statistics indicate that the modified grading systems, Systems 3 and 4, perform as well as or better than the existing system. The proportion of the variance of $/MLV that can be attributed to grade segregation and regression on log diameter is larger, 79 and 80 percent for the modified system, as compared with 75 and 77 percent for the existing system.

[4] *Overgrown limb size is a measurement of the surface bark pattern and not a measurement of the original limb. The surface bark pattern expands with the tree growth, sometimes reaching more than twice the diameter of the original limb.*

Table 1.--*Performance statistics of four log grading system applications*

Log grade	Number of logs	Average		Significance of regression form[1/]			Proportion of variance in $/MLV attributable to grade segregation and regression on diameter (percent)
		Diameter (inches)	$/MLV)	First degree	Second degree	Third degree	
SYSTEM 1 - EXISTING GRADING SYSTEM APPLIED TO DIAGRAM RECORDS							
1	41	41.1	260.71	NS	NS	NS	--
2	60	35.7	233.02	**	NS	NS	--
3	72	32.8	207.83	**	NS	NS	--
5	253	22.6	141.90	**	NS	NS	--
Common							75
SYSTEM 2 - EXISTING GRADING SYSTEM APPLIED BY CHECK SCALER TO LOGS IN SAWMILL YARD							
1	78	38.6	252.48	**	**	NS	--
2	39	33.6	221.15	**	NS	NS	--
3	54	32.1	201.95	**	NS	NS	--
5	255	22.9	142.39	**	NS	NS	--
Common							77
SYSTEM 3 - MODIFIED GRADING SYSTEM APPLIED TO DIAGRAM RECORDS OVERGROWN LIMBS ≤ 1 INCH ARE NOT PRIMARY DEFECTS LIMBS ≤ ONE-HALF INCH ARE NOT PRIMARY DEFECTS							
1	77	37.3	247.81	**	**	NS	--
2	71	34.2	223.13	**	NS	NS	--
3	49	30.4	182.94	**	NS	NS	--
5	229	22.3	138.20	**	NS	NS	--
Common							79
SYSTEM 4 - MODIFIED GRADING SYSTEM APPLIED TO DIAGRAM RECORDS OVERGROWN LIMBS ≤ 2 INCHES ARE NOT PRIMARY DEFECTS LIMBS ≤ ONE-HALF INCH ARE NOT PRIMARY DEFECTS							
1	104	36.7	245.40	**	**	NS	--
2	66	32.9	206.31	**	NS	NS	--
3	35	29.7	179.23	*	NS	NS	--
5	221	22.0	136.30	**	NS	NS	--
Common							80

[1/] ** Significant at the 1-percent level.
* Significant at the 5-percent level.
NS Not significant.

Regression curves of $/MLV on log diameter for the log grades in each grading system are shown in figure 3. Note the similarity between Systems 2, 3, and 4.

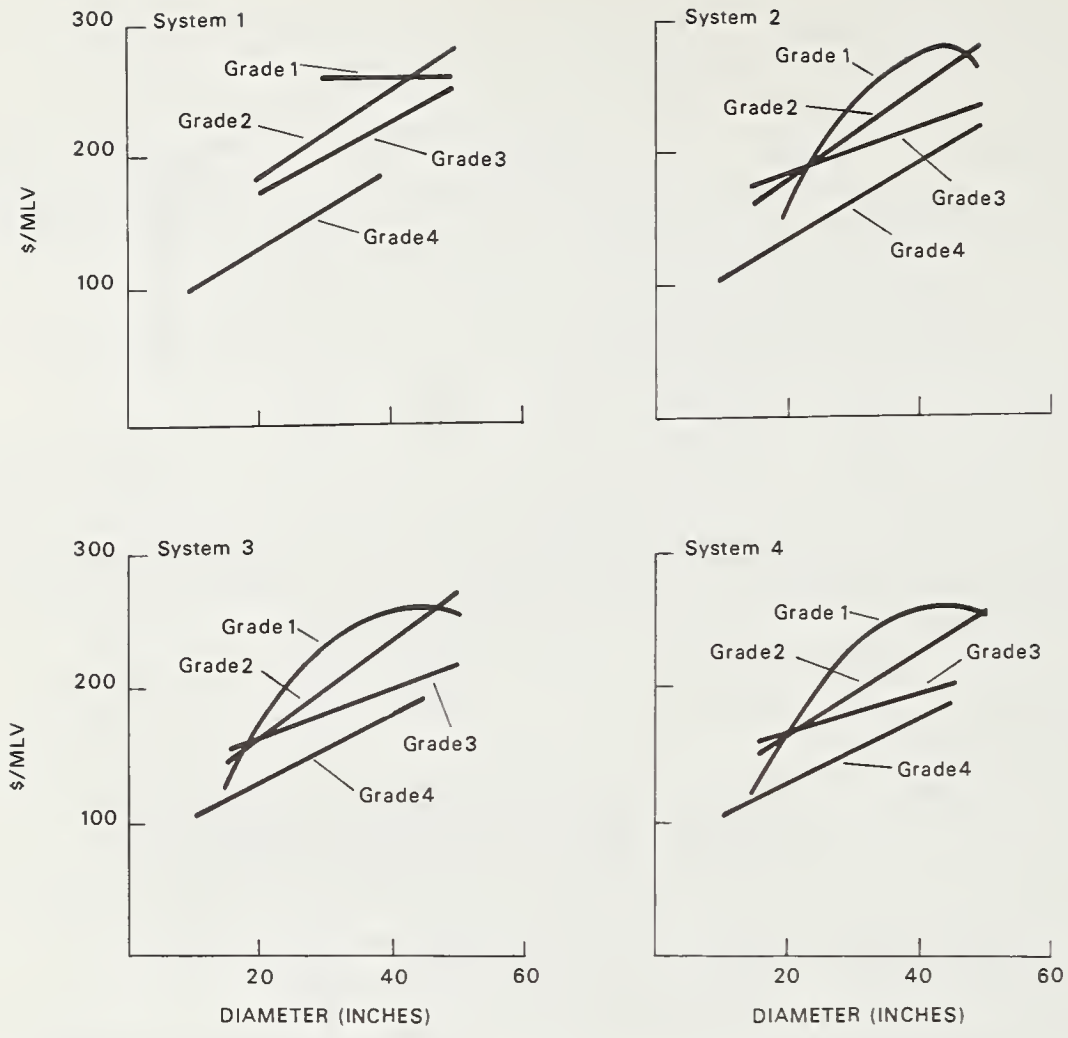

Figure 3.—Regression curves of $/MLV on log diameter for the log grades in four grading systems.

CONCLUSIONS

The study results indicate that the grading specifications for the existing system for grading sugar pine saw logs in trees can be modified without reducing the performance of the system. In fact, it appears that modification would improve the accuracy of estimates of log $/MLV. Either System 3 or System 4 allows a grader to ignore problem surface characteristics. In terms of estimating $/MLV accurately, they appear to be almost equal.

Several factors should be considered in making a choice between Systems 3 and 4. The 1-inch allowance for overgrown limbs in System 3 is more closely alined with the application problems reported by graders. They have had difficulty with the smaller overgrown limbs. Field application tests of Systems 3 and 4 would help resolve this point. The use of existing lumber recovery data is another consideration. It would be desirable to modify the existing system and retain the use of the associated performance data. The performance characteristics of System 3 are more similar to System 2 than those of System 4. For these reasons System 3 appears to be the better of the two modifications.

GPO 985-938

Henley, John W.
1972. Grading sugar pine saw logs in trees. USDA Forest Service Res. Pap. PNW-132, 8 p. Pacific Northwest Forest and Range Experiment Station, Portland, Oregon.

A study of surface characteristics and lumber recovery information obtained for 426 logs from 64 trees indicates that problems encountered in applying a log grading system to sugar pine trees can be alleviated by modifications in the specifications. The modifications do not appear to decrease the performance of the grading system.

Keywords: Sugar pine, log grades.

Henley, John W.
1972. Grading sugar pine saw logs in trees. USDA Forest Service Res. Pap. PNW-132, 8 p. Pacific Northwest Forest and Range Experiment Station, Portland, Oregon.

A study of surface characteristics and lumber recovery information obtained for 426 logs from 64 trees indicates that problems encountered in applying a log grading system to sugar pine trees can be alleviated by modifications in the specifications. The modifications do not appear to decrease the performance of the grading system.

Keywords: Sugar pine, log grades.

Henley, John W.
1972. Grading sugar pine saw logs in trees. USDA Forest Service Res. Pap. PNW-132, 8 p. Pacific Northwest Forest and Range Experiment Station, Portland, Oregon.

A study of surface characteristics and lumber recovery information obtained for 426 logs from 64 trees indicates that problems encountered in applying a log grading system to sugar pine trees can be alleviated by modifications in the specifications. The modifications do not appear to decrease the performance of the grading system.

Keywords: Sugar pine, log grades.

Henley, John W.
1972. Grading sugar pine saw logs in trees. USDA Forest Service Res. Pap. PNW-132, 8 p. Pacific Northwest Forest and Range Experiment Station, Portland, Oregon.

A study of surface characteristics and lumber recovery information obtained for 426 logs from 64 trees indicates that problems encountered in applying a log grading system to sugar pine trees can be alleviated by modifications in the specifications. The modifications do not appear to decrease the performance of the grading system.

Keywords: Sugar pine, log grades.

The mission of the PACIFIC NORTHWEST FOREST AND RANGE EXPERIMENT STATION is to provide the knowledge, technology, and alternatives for present and future protection, management, and use of forest, range, and related environments.

Within this overall mission, the Station conducts and stimulates research to facilitate and to accelerate progress toward the following goals:

1. Providing safe and efficient technology for inventory, protection, and use of resources.
2. Development and evaluation of alternative methods and levels of resource management.
3. Achievement of optimum sustained resource productivity consistent with maintaining a high quality forest environment.

The area of research encompasses Oregon, Washington, Alaska, and, in some cases, California, Hawaii, the Western States, and the Nation. Results of the research will be made available promptly. Project headquarters are at:

College, Alaska
Juneau, Alaska
Bend, Oregon
Corvallis, Oregon
La Grande, Oregon
Portland, Oregon
Roseburg, Oregon
Olympia, Washington
Seattle, Washington
Wenatchee, Washington

The FOREST SERVICE of the U.S. Department of Agriculture is dedicated to the principle of multiple use management of the Nation's forest resources for sustained yields of wood, water, forage, wildlife, and recreation. Through forestry research, cooperation with the States and private forest owners, and management of the National Forests and National Grasslands, it strives — as directed by Congress — to provide increasingly greater service to a growing Nation.